James River TMDLs

City of Richmond Kick-Off Meeting

April 4, 2006

New River-Highlands
RC&D

TMDL Process

- Water Quality Assessment
  - Required by Clean Water Act (1972)
  - 305b Report
  - 303d List (Impaired Waters)
- TMDL Development
  - Required by Clean Water Act (1972)
  - Motivated by legal action (consent decree)
- Implementation Plan Development
  - Required by Water Quality Monitoring, Information, and Restoration Act (WQMIRA)
- Implementation
  - Staged Implementation

TMDL in Brief

- Pollutant load that a water body can assimilate without violating water quality standards
- Pollutant Specific
- Watershed Based
- Considers:
  - All pollutant sources
  - Seasonality
  - Critical conditions

TMDL in Brief

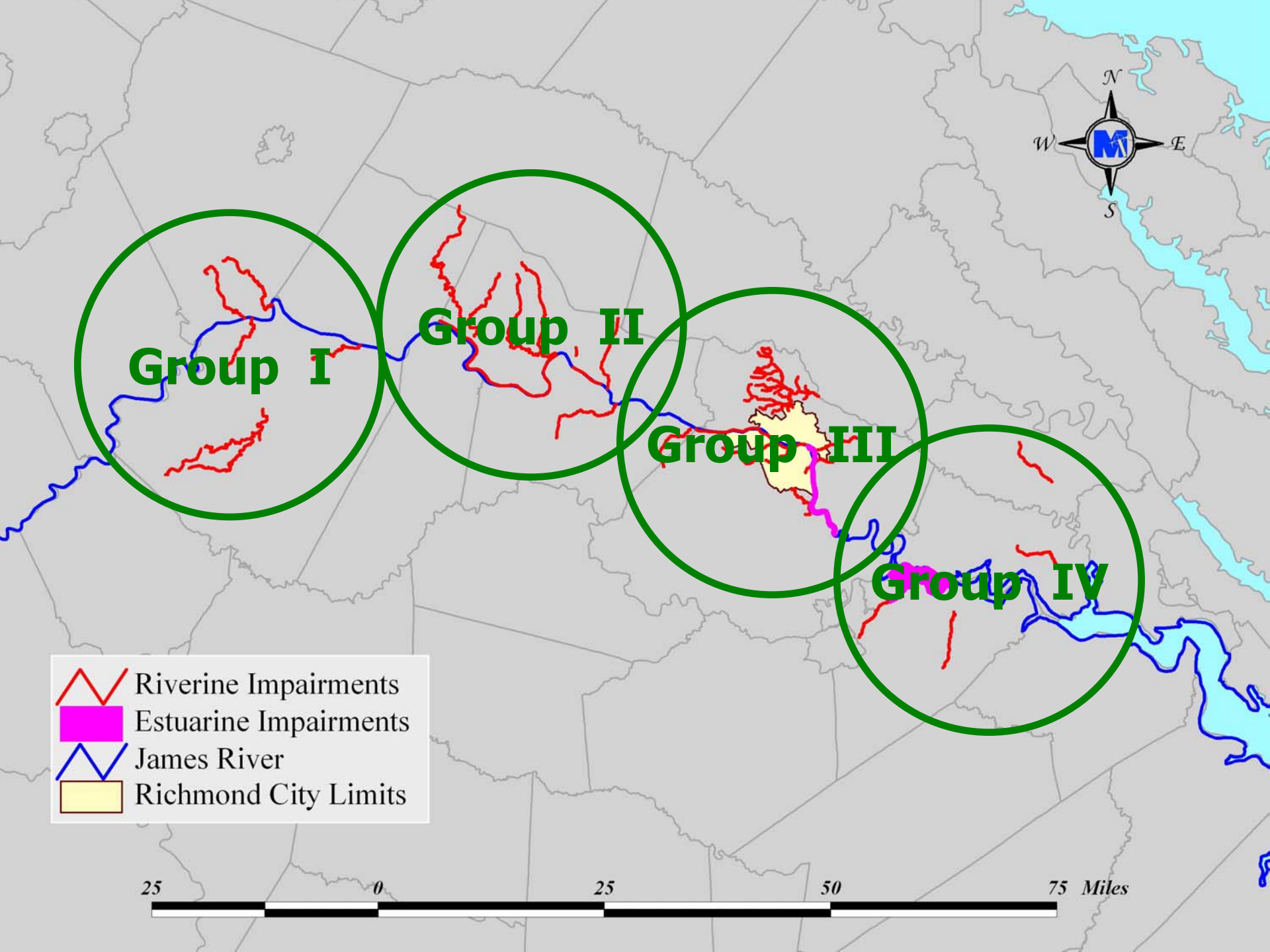
- TMDL = LAs + WLAs + MOS
  - LA = Load Allocation, non-permitted sources
  - WLA = Waste Load Allocation, permitted sources
  - MOS = Margin of Safety

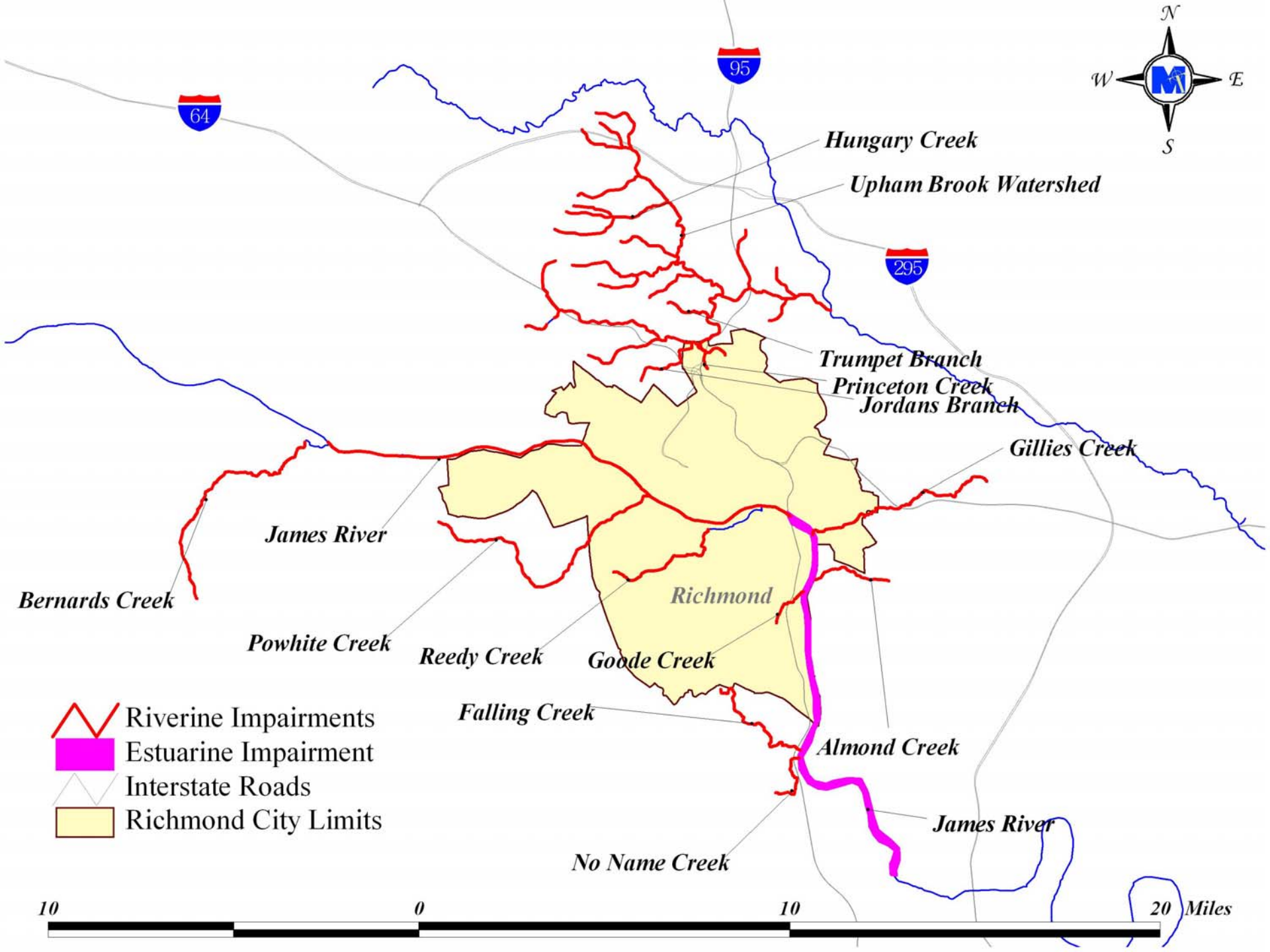
Project Background

- Contracted by VADEQ
  - New River RC&D - Contract Administration
  - MapTech – Technical Consultant
- Impairment Details
  - 39 Impairments in the James River watershed
  - Fecal Bacteria (*E. coli*, *Enterococcus*)
    - Listed for fecal coliform
    - Listings beginning in 1998

Project Background

- Group I
  - 9 impairments
  - Albemarle, Buckingham
- Group II
  - 8 impairments
  - Cumberland, Fluvanna,Goochland, Louisa, Powhatan
- Group III
  - 16 impairments
  - Richmond City, Chesterfield, Henrico, Powhatan, Prince George
- Group IV
  - 6 impairments
  - Hopewell City, Charles City, Chesterfield , New Kent, Prince George


Group I
Group II
Group III
Group IV
N
W
E
S
Riverine Impairments
Estuarine Impairments
James River
Richmond City Limits
25
0
25
50
75 Miles


N
W
E
S
64
95
295
Hungary Creek
Upham Brook Watershed
Trumpet Branch
Princeton Creek
Jordans Branch
Gillies Creek
James River
Bernards Creek
Richmond
Powhite Creek
Reedy Creek
Goode Creek
Falling Creek
Almond Creek
James River
No Name Creek
Riverine Impairments
Estuarine Impairment
Interstate Roads
Richmond City Limits
10
0
10
20 Miles

Stream Name	Municipality(ies)	Location Description
Bernards Creek	Chesterfield, Powhatan	Mainstem of Bernards Creek
Powhite Creek	Chesterfield, Richmond City	Headwaters to the James.
Reedy Creek CSO	Richmond City	Headwaters to the James.
Upham Brook	Henrico	Headwaters to the Chicahominy River, includes all tributaries.
Princeton Creek	Henrico	Headwaters to Upham Brook.
Jordans Branch	Henrico	Headwaters to Upham Brook.
Trumpet Branch	Henrico	Headwaters to Upham Brook.
Hungary Creek	Henrico	Headwaters to Upham Brook.
Gilles Creek	Henrico, Richmond City	Headwaters to the James.
Goode Creek CSO	Richmond City	Confluence with Broad Rock Creek to the James River.
Almond Creek	Richmond City	Headwaters to the James including unnamed tributaries.
Falling Creek	Chesterfield	Falling Creek Reservoir Dam to the James.
No Name Creek	Chesterfield	Headwaters to the James, includes all tributaries.
James River	Richmond City	Confluence of Tuckahoe Creek to Williams's Island Dam.
James River	Richmond City	Williams Island Dam to the fall line.
James River	Chesterfield, Henrico, Richmond City	Fall Line (Mayos Bridge) to the Appomattox River.

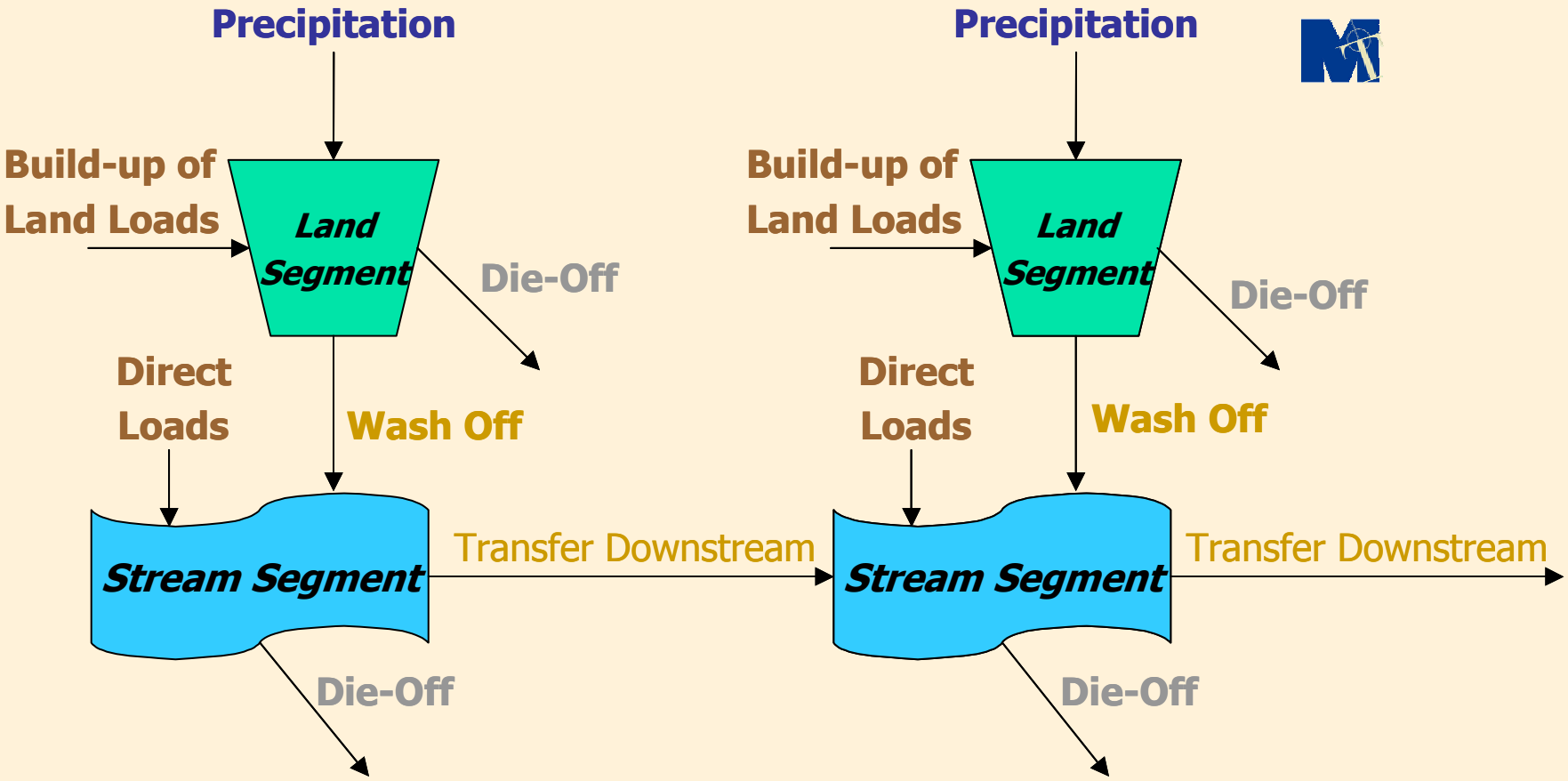
Applicable Standards

- Listing
  - Instantaneous Fecal Coliform Standard
    - 1,000 cfu/100 ml
- Current Primary Contact
  - *E. coli* – Free-Flowing
    - Instantaneous Standard = 235 cfu/100 ml
    - Geometric Mean Standard = 126 cfu/100 ml
  - *Enterococcus* – Tidal
    - Instantaneous Standard = 104 cfu/100 ml
    - Geometric Mean Standard = 35 cfu/100 ml

Models

- Calibrated to monitored conditions
- Upland/Free-flowing
  - Watershed-based
  - Continuous time interval
  - Land-applied, direct loads
  - HSPF or SWMM
- Tidal Dynamics
  - CE-QUAL-2E
  - WASP/DYNHYD
  - Other?
- Fecal Coliform modeled – Tanslated to *E. Coli* & *Ent*.

Conceptual Model



Hydrologic Modeling Components

- Climatic data
- Land use
- Topography
- Soils
- Stream channel characteristics
- Point source discharge/withdrawal
- Flow data

Water Quality Modeling Components:
Fecal Bacteria

- Sources
  - Fecal Production
  - Fecal Bacteria Densities
  - Fecal Bacteria Distribution
- Delivery Mechanisms
  - Direct
  - Land-applied
- Temporal Variation
  - Seasonal
  - Driven by precipitation

Source Assessment

- Permitted discharges
  - Wastewater treatment facilities
- Human
- Pets
- Livestock
- Wildlife

Permitted Discharges

- Historical measurements (DMR) for calibration period
- Chlorine / Fecal Bacteria Translator
- Design/Permit values for allocations
- Direct load to stream

Human Source

- U.S. Census
  - Population
  - Housing Units
  - On-site Sewage Treatment Systems
- Sanitary Sewer
  - Overflows
    - By-pass
    - Back-up
  - Land-applied / direct deposition
    - Proximity to stream

Human Source

- Septic Systems
  - Failure to soil surface throughout year
  - Lateral movement continuously to stream
- Straight Pipes
  - Direct continuous input into stream
- Biosolids
  - Land-applied

Pet Source

- Population/household based on:
  - Literature Values
  - Veterinarians
  - Animal Control
- Distributed based on Housing Units
  - U.S. Census
- Land-applied
- Pet Waste Management Ordinances?

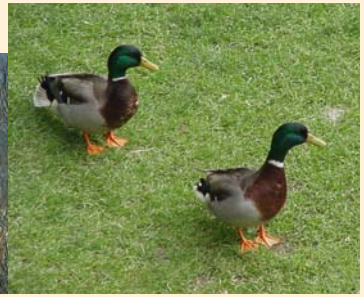
Livestock Source

- Population
  - Virginia Ag. Statistics
  - Consultation with local SWCD,NRCS, VADCR, producers
  - Watershed visits
  - Mounted Police?
- Distribution of waste
  - Pastured
  - Confined, waste collected, spread
  - Direct deposition to the stream
- Seasonal varying applications

Wildlife Source

- Population based on data provided by VDGIF biologists, include:

Raccoon	**Muskrat**	**Beaver**
Deer	**Turkey**	**Goose**
Ducks	***Minor Sources***	



- Distribution of waste based on habitat
  - Land-applied
  - Direct deposition to the stream
- Seasonal variations based on migration patterns and food sources
- City wildlife management programs?

Typical Modeling Approach

- Calibration/Validation
  - Existing conditions
- Allocation
  - Maximum Permitted Loads
  - Eliminate Illicit Discharges
  - Reduce other anthropogenic sources
  - Reduce wildlife sources as needed
  - Endpoints:
    - Instantaneous and Geomentric Mean Standards